

EXHIBIT 10

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Demand for the Ultimate Fighting Championship: An Econometric Analysis of PPV Buy Rates

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Abstract: This study provides a framework by which the UFC can analyze the determinants of its PPV buy rates, a form of direct demand for the UFC. Accurately deriving demand is incredibly important in the UFC's goal to maximize revenue and further grow the sport and equally as important for promoters, TV and cable networks. Given that the endogenous growth of the UFC has slowed greatly, specific event characteristics have emerged as the primary factors that govern the buy rate. Using a combination of empirical regression analysis and industry expertise, the UFC and promoters and others can more accurately estimate the buy rates of upcoming events.

Key words: gaming; sports; econometric analysis

JEL codes: C1, M1

In the past fifteen years, the sport of mixed martial arts has grown from no-rules, bareknuckle "human cockfighting" into a highly professional and incredibly popular mainstream sport with millions of fans around the world. Since purchasing its biggest rival in 2007, the Las Vegas-based Ultimate Fighting Championship (UFC) has been undisputedly the largest, best quality and most popular MMA promotion in the world. In 2008, Forbes wrote an article calling it the "Ultimate Cash Machine", valuing it at \$1 billion (Miller Matthew, 2008). Dana White, the president of the UFC, estimated the company's net worth at \$2.5 billion in September of 2010 (Meyers Tommy, 2010). Georges St. Pierre, the UFC's biggest star, makes upwards of \$3 million per fight in prize money and PPV (Pay Per View) sales bonuses, and then earns millions of dollars from his endorsements by Gatorade, Under Armour, and other companies (Warner Brian, 2013). The international market for the UFC flourishes, especially in Brazil, Canada, Japan, and the United Kingdom. In Brazil, middleweight champion Anderson Silva is featured in Burger King commercials and on major TV shows, and has been called "bigger than Kobe Bryant and LeBron James" (Chiappetta Mike, 2012). While growth in popularity has tapered off in the recent years, the UFC has already established itself as a staple in the sports world.

Much of the UFC's revenue comes in the forms ticket sales to live events, licensing fees to cable television networks to broadcast its products, and merchandise sales, but the majority of the UFC's revenue is generated through purchases of its televised events on pay-per-view. In this study, we will analyze the factors that determine the number of buys a given UFC pay-per-view event gets, which will be done through the construction of an

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empirical econometric model. Examining the determinants of the promotion's pay-per-view buy rates provides insight into deriving demand for the UFC.

1. Background Information

UFC fights take place in an octagonal cage between two fighters of equal weight class, accompanied inside the octagon by a referee. Most bouts consist of three five-minute rounds, while main events and title bouts have five five-minute rounds. Similar to boxing, the UFC uses the 10-Point Must scoring system, where each of three judges awards 10 points to the perceived round winner, and 9 points or less to the round loser. Scoring based on effective striking, effective grappling, aggression, and octagon control. There are 31 illegal fouls that can be committed, most common of which are strikes to the back of the head, throat, eyes, groin, kidney, or spine. Other fouls include head butting, hair pulling, scratching, biting, fish hooking, downward elbow strikes, kicks to the head of a grounded opponent, grabbing the fence, etc.¹ Other than the specified illegal techniques, any punch, kick, elbow strike, knee strike, takedown, chokehold, or submission hold is fair game. A fight can be won by referee stoppage due to a knockout or submission, or won by judges' decision if time expires without a finish.

There are 8 different weight classes, each with its own champion. Originally only 5 weight classes existed: heavyweight (265 lb. maximum), light heavyweight (205), middleweight (185), welterweight (170), and lightweight (155). In late 2010, the UFC added the featherweight (145) and bantamweight (135) divisions following the discontinuation of the Zuffa-owned World Extreme Cagefighting promotion. The flyweight (125) division was added in March 2012, as was the women's bantamweight (135) division in February 2013. The UFC plans to add a women's strawweight (115) division in the near future.

UFC events consist of 13 fights, 5 on the main card and 6-8 on the undercard. For most events, the main card is broadcast on PPV for \$44.95 for standard definition and \$54.95 for high definition (with the exception of UFC 168 which was \$5 more). PPVs are almost always scheduled for Saturday nights at 10:00 PM EST. The preceding undercard fights are broadcast on cable TV and/or streamed free online. The UFC broadcasted exclusively through Spike TV from 2005-2011, but that partnership ended when the Zuffa switched to FOX Networks to broadcast UFC events and other shows, such as *The Ultimate Fighter*, *UFC Unleashed* highlight shows, and *UFC Countdown* promotions. In 2013, the UFC put on 26 events per year, about 13 of which were PPV events. The average buy rate was roughly 469,000, for an annual total 6,095,000 buys. Priced at \$44.95/\$54.95, the UFC generated at least \$274 million in PPV revenue in 2013.

2. History of the UFC²

The very first UFC event took place on November 12, 1993, in a setting very different than that of today. A Brazilian martial artist named Rorion Gracie wanted to prove to the world that Brazilian Jiu-jitsu, his family's style of martial arts, fared superior to all others. To prove his claim, Gracie partnered with Art Davie, a wealthy businessman and acting promoter, and Bob Meyrowitz, president of Sema-phore Entertainment Group, which specialized in broadcasting pay-per-view sporting events. Together, they created a one-night, eight-man tournament featuring fighters of all different styles to compete in no-holds barred combat — no gloves, no weight

¹ "Rules and Regulations", UFC.com.

² This summary of the history of the UFC gathers information from multiple sources, all of which are referenced and cited in this section.

classes, no time limits, and essentially no rules. The event, now known as UFC 1, drew 86,592 pay-per-view buys and was considered a box office success. And, as Rorion predicted, his 170-pound little brother Royce won the tournament, defeating his much taller and heavier opponents with superior grappling technique.

Following the success of their inaugural event, SEG continued to promote UFC events until 1996, when a political crusade led by Senator John McCain (R-AZ) halted the sport in its tracks. McCain labeled the sport “human cockfighting” and wrote letters to the governors of every state in the country calling for the banning of mixed martial arts; 36 of the 50 states obliged (Plotz David, 2014). The problem compounded in 1997, when McCain assumed the role of chairman of the commerce committee, which oversees the cable industry. Under political pressure, most of the nation’s major cable companies stopped broadcasting UFC events. In response to the political backlash, rules were modified, including the instatement of weight classes, timed rounds, and the end of the one-night tournament format. On November 17, 2000, the UFC held its first officially sanctioned event in Atlantic City, New Jersey. Nevertheless, while events continued to be held, popularity was low, financial losses were huge, and the outlook looked bleak for the company and the sport. It was during these “dark ages” when the UFC changed ownership. Dana White, who at the time was a manager for a few UFC fighters, learned that SEG was trying to sell the UFC. He and his friends Lorenzo and Frank Fertitta, owners of Station Casinos, bought the UFC in January of 2001 for approximately \$2 million, and founded Zuffa, LLC to be the UFC’s parent entity. On September 2001, the UFC returned to pay-per-view cable television with the broadcasting of UFC 33. By aggressively increasing their advertising and corporate sponsorships, Zuffa steadily reignited interest in the new Ultimate Fighting Championship.

One of the most monumental cards in UFC history was UFC 40, held on November 22, 2002. The event, headlined by a championship grudge match between Tito Ortiz and Ken Shamrock, received significant media coverage from media titans like ESPN and USA Today. The heavily promoted event drew 150,000 PPV buys and nearly sold out the Las Vegas’ MGM Grand Garden Arena for a gate of \$1,540,000. Despite the profits made from UFC 40, financial woes continued. In 2004, Zuffa reported losses of \$34 million since purchasing the UFC in 2001 (Clow Kenneth E., & Donald Baack, 2012).

In January 2005, the UFC struck a deal with Spike TV to air a reality television show called *The Ultimate Fighter*, featuring sixteen young MMA fighters competing for a contract with the UFC. The free finale event, headlined by the show’s finalists Forrest Griffin and Stephan Bonnar, is widely considered to be the most important fight in UFC history. The first PPV event following the show’s finale was UFC 52, featuring Chuck Liddell and Randy Couture, the two opposing coaches on *The Ultimate Fighter* TV show. The event set a UFC record 300,000 PPV buys, doubling the previous high set by UFC 40. Following the success of *The Ultimate Fighter*, Spike TV began airing free live *UFC Fight Night* events, replay fights on *UFC Unleashed*, and *UFC Countdown* specials promoting upcoming PPV events.

In 2006, the UFC surged into mainstream popularity. UFC 57, a rematch between Liddell and Couture, drew 410,000 PPV buys; UFC 66, a grudge match between Liddell and Tito Ortiz, drew 1,050,000 buys. 2006 saw the UFC break the record for PPV revenues in a single year, surpassing boxing and WWE professional wrestling. In 2007, both *Sports Illustrated* and *ESPN the Magazine* ran cover stories on the rise of the UFC. In March that same year, the UFC acquired PRIDE Fighting Championships, its Japan-based rival promotion, for \$70 million.

The buy rate peaked on July 11, 2009, when UFC 100 set the standing record of 1,600,000 PPV buys. Since 2010, however, growth has slowed significantly, and there is talk that the UFC may have maxed out interest in the United States. Despite the significant tapering of growth in the past four years, the UFC continues to make

expansionary moves. The UFC has aggressively expanded all over the world, holding events in Europe, Brazil, Japan, Australia, China, and the United Arab Emirates. These international ventures are often pioneered by a UFC fighter from the region, and sometimes include an international season of *The Ultimate Fighter*. Additionally, the UFC continued to purchase and discontinue competing MMA promotions, including World Extreme Cagefighting, Affliction, Elite XC, and Strikeforce. In 2011, the UFC ended its longtime deal with Spike TV and struck a new seven-year deal with the much larger Fox Broadcasting Company.

Needless to say, the UFC has proven its significance in the sports world. With its business model being heavily event driven, there is a need for examination of these events from an economic perspective. The question of what factors most significantly drive fan interest in a given UFC event deserves attention from the lens of sports econometrics.

3. Theoretical Demand for Sport

The basis of demand for the UFC is derived from Borland and Macdonald's 2003 study on demand for sport. This study measures direct demand for the UFC in the form of PPV buy rates. In constructing theoretical framework for demand for a live sporting event, Borland and Macdonald segment the demand determinants into five categories:

(1) form of consumer preferences — habit; age of club; (2) economic price — travel costs; income; market size (including demographic composition of population); availability of substitutes (TV; other sporting events); macroeconomic factors (rate of unemployment); (3) quality of viewing — quality of seating and stadium; stadium size; timing of contest; (4) characteristics of the sporting contest — uncertainty of outcome; “success” of competing teams; quality of contest; significance of contest; and (5) supply capacity (Borland J. & Macdonald R., 2003).

Transforming these general sport demand determinants into UFC-specific demand determinants requires some twisting of the framework. The first category of consumer preferences is outside of any party's control. The second category, in addition to macroeconomic effects, deals with price of viewership. Neoclassical economic theory indicates that price has an inverse effect on demand — as price goes down, the number of purchases of a product increases. The price of UFC PPVs has risen significantly in the past, starting at \$29.95 in 2001 and inflating to \$44.95 in 2006. Since then, the price has remained the same with the exception of UFC 168, which was \$5.00 more expensive. The availability of substitutes, especially free ones, may also affect demand for a UFC PPV. The third category of quality of viewing is not applicable here, as every purchaser of the PPV views exactly the same broadcast. The only difference would be standard definition (\$44.95) versus high definition (\$54.95), but the ratio of SD to HD buys is unable to be found. Event scheduling may also play a factor, especially the frequency of UFC events. And, while the UFC schedules all PPV events on Saturday nights, the specific weekend in the year may have an effect on buy rate. The fourth category is the most relevant to this study, since the event characteristics has the most determining power over the buy rate as well as the most variation of all the categories. Lastly, the fifth category supply capacity is not applicable, as there is no limit to the number of PPVs that can be purchased.

Of the event characteristics, most important is the set of bouts on the PPV main card, highlighted by the main event fight. Other event characteristics include the number of championship bouts on the card, the weight classes of the fights, the event location, the quality and quantity of the promotional material, etc. Since the main event is

generally by far the most heavily promoted fight, the main event characteristics are of especially high interest. In addition to title and weight class, notable characteristics of the main event include the pre-fight betting odds; whether or not it features an *Ultimate Fighter* coaches match, a grudge match, or a rematch; the nationalities of the fighters; and more. Various literature on the topic analyzes these effects with different degrees of rigor, giving insight into what event characteristics account for the variance in PPV buy rates.

4. Literature Review

Though rather sparse, the literature on direct demand for the UFC does exist and is generally quite insightful. The majority of pieces come in the form of posts on MMA blog sites, most of which are surprisingly quite professional. Additionally, there have been three peer-reviewed econometric studies on demand for the UFC. First, we will review the conclusions of some relevant blog posts before delving deeper into the academic studies.

A 2013 Yahoo! Sports article (Napoli Joe, 2013) looks at simple relationships between buy rates and determining factors. In his qualitative article, author Joe Napoli looks at how PPV numbers are influenced by weight classes, title fights, grudge matches, an *Ultimate Fighter* show tie in, rematches, competitive matchups, and certain superstar fighters. First, he surmises that while there no direct correlation between weight class and buy rate, higher weight classes do tend to draw more interest than lower weight classes. This could be due to the long-standing notion that bigger bodies attract more interest, or to the fact that the lighter weights are newer and less established than the heavier ones. Most likely it is a combination of both. The effect of a title fight is difficult to measure, as champions are usually successful enough to be draws regardless of a title. Events can be successful regardless of whether or not there is a title fight; however, title fights give legitimacy and allow semi-popular fighters to headline events that they otherwise wouldn't.

Grudge matches, though constrained by a low sample size, apparently do generate a spike in the buy rate. Therefore, it makes sense for the UFC to promote two fighters as bitter enemies, although the shtick would likely get old with overuse. A card tied in with *The Ultimate Fighter* reality show, where the main event features a bout between the two coaches, averages 206,000 buys higher than the PPV average. This makes sense, as the show promotes the eventual coaches' bout for an entire season. But usually, the coaches are big name fighters already, who would likely draw quite well with or without the reality show promotion. *The Ultimate Fighter* especially shines when coupled with the grudge match aspect, as the show can build on the animosity between the coaches for weeks leading up to the fight. Surprisingly, rematches generally have no effect on a buy rate compared to the first matchup, even if the first bout was highly entertaining.

The most interesting part of this article discusses the importance of "a good dance partner". Superstars in the UFC don't always draw high numbers; they need a competitive opponent in order to garner the desired high buy rates. Anderson Silva, one of the UFC's more popular champions, drew only 300,000 buys in a squash match against Patrick Cote, but drew 725,000 buys facing a much more threatening Vitor Belfort. Lastly, Napoli looks at six current UFC "superstars" that should expect to draw over 400,000 buys for a card they headline: Georges St. Pierre, Jon Jones, Anderson Silva, Cain Velasquez, Junior dos Santos, and Ronda Rousey.

A 2013 article on CagePotato.com (Chan Oliver, 2013) breaks down the UFC's PPV numbers from 2008 to 2012, focusing specifically on steady increase in buy rates from 2008 to 2010 before the sharp decline in 2011 and 2012. The mean PPV buy rate between those five years was 526,470 buys. Events with a title fight averaged a buy rate 15% above that mean, while events without a title fight averaged 27% below it. Events headlined by *The*

Demand for the Ultimate Fighting Championship: An Econometric Analysis of PPV Buy Rates

Ultimate Fighter coaches averaged 940,000 buys, a whopping 79% above average. An event with a heavyweight bout in the main or co-main event did 42% better than the average. Most notably, the average buy rate of cards where the main event was changed due to injury was 23% below the mean buy rate.

Additionally, author Oliver Chan looks at the increasing number of events through the years, as well as the changing ratio of PPV events to free cable events. From 2008-2010, the ratio of PPV to free events was about 3:2. In 2012, the UFC aired a record 32 events, and free events outnumbered PPV events 18 to 14. He postulates that the decline in buy rates in 2011 and 2012 was due in part to the increased availability of free UFC events, as potential customers would not be willing to buy a PPV event when there are plenty of free UFC. The UFC seemed to recognize this, and retracted back to 26 events in 2013, half of which were PPV.

Lastly, the article ranks fighters by average career PPV draw by averaging the buy rates of the events on which they fought on the main card. According to their data, the top five biggest draws were Brock Lesnar (265), Georges St. Pierre (170), Frank Mir (265), Forrest Griffin (205), and Thiago Alves (170). However, the major flaw we see with this analysis is that fights on the main cards are promoted with different degrees of emphasis. A fighter can ride on the coattails of a superstar headliner and still be credited with being a big draw, even though he had very little to do with the true drawing power of the event. Additionally, a fighter who is considered to be a good opponent for superstar fighters will be credited the drawing power of the superstar, when in reality he is merely the dance partner.

While many bloggers write analysis pieces on UFC's pay-per-view numbers, academic literature on the topic is scarce. Only three peer-reviewed academic studies have been done on the topic of demand for the UFC. In 2012, Nicholas Watanabe wrote the first paper of its kind, analyzing demand for UFC pay-per-views by running an ordinary least squares regression model (Watanabe Nicholas, 2012). The following year, Tainsky, Salaga, and Santos wrote a similar paper concentrating on different determinant variables (Tainsky S., Salaga S. & Santos C. A., 2013). Later that year, Watanabe wrote a follow up to his original paper, this time looking at both attendance and PPV buy rate as dependent variables (Watanabe Nicholas, 2013). In the following section, we will review each of the three papers, compare their models and results, and eventually contrast them against our own.

Watanabe's 2012 paper (Watanabe, 2012) captured 81 observations from UFC 33 in 2001 until an unspecified time in 2011. To estimate his results, he used the following model:

$$\begin{aligned} PPV \text{ buys} = & \beta_0 + \beta_1 PPV \text{ Price} + \beta_2 GDP \text{ per capita} + \beta_3 \text{ total population} + \beta_4 \text{ days from previous event} + \\ & \beta_5 \text{ weekend fights} + \beta_6 \text{ holiday fights} + \beta_7 \text{ international event} + \beta_8 TUF \text{ reality tie-in} + \beta_9 \\ & \text{number of fights on cable} + \beta_{10} \text{ internet streamed fights} + \beta_{11} \text{ featherweight champ} + \beta_{12} \\ & \text{welterweight champ} + \beta_{13} \text{ middleweight champ} + \beta_{14} \text{ lightweight champ} + \beta_{15} \text{ light} \\ & \text{heavyweight champ} + \beta_{16} \text{ heavyweight champ} + \beta_{17} \text{ number of bouts} + \varepsilon \end{aligned}$$

The dependent variable is the number of buys a PPV event garners, averaging at around 470,000 for his study. *PPV price* represents the price of a PPV event, as cheap as \$29.95 in the early 2000s. The *GDP per capita* (inflated to 2011 dollars) and *total population* variables correspond to the years in which the UFC event was held. These two variables represent the macroeconomic effects at the time, giving consideration to the purchasing power and size of the addressable audience. The next few variables deal with scheduling, including the days since the last UFC event, and dummy variables indicating whether the fight was held on a holiday or weekend. *International event* is a dummy variable denoting if the event took place outside of the United States. The *TUF reality tie-in* dummy variable indicates a card featuring an *Ultimate Fighter* coaches' match. *Internet streamed*

Demand for the Ultimate Fighting Championship: An Econometric Analysis of PPV Buy Rates

*fight*s is a dummy variable telling if the event featured preliminary matches streamed free online, a practice that was only beginning at the time but has since become commonplace. The *number of fights on cable* explains the number of preliminary matches shown free on cable television before the main card. The last variable represents the total number of bouts in the entire event. The rest of the variables are dummies indicating whether or not the bout featured a title fight, and if so, at which weight class.

The model was run using ordinary least squares multiple linear regression with robust standard errors. The regression's r-squared value was 0.6631, meaning that 66.31% of the variation in PPV buys is explained by this model. The regression results are shown below:

Table 1 PPV Demand OLS Regression with White's Robust Standard Errors

	Coeff.	Std. err.	t-stat.	$p > t $
PPV price	36406	15796	2.30**	0.024
GDP per capita (\$thousands)	62856	38324	1.64	0.106
Total population (thousands)	-0.0122	0.0191	-0.64	0.526
Days since previous event	-1418	1551	-0.91	0.364
Weekends	61007	138536	0.44	0.661
Holiday	-228115	89834	-2.54**	0.014
International events	-194746	65405	-2.98***	0.004
Reality tie-in	-30964	88218	-0.35	0.727
Number of cable TV fights	-67486	24632	-2.74***	0.008
Internet streamed fights	-5167	98280	-0.05	0.958
Feather championship	496127	108186	4.59***	0.000
Welter championship	152669	69327	2.20**	0.031
Light championship	67369	52268	1.29	0.202
Middle championship	-15305	54934	-0.28	0.781
Light heavy championship	188788	70970	2.66***	0.010
Heavy championship	274251	72970	3.76***	0.000
Number of bouts	59315	30514	1.94**	0.057
Constant	-1133094	4387842	-0.26	0.797

Note: Dependent variable is PPV buys (81 observations). * Significant at the 10% level, ** significant at the 5% level, and ***significant at the 1% level.

According to these results, after controlling for the other variables in the model, the attributes that draw the highest PPV buy rates are the featherweight title (+496K), the heavyweight title (+274K), the light heavyweight title (+189K), and finally the welterweight title (+153K). Events shown on a holiday and events held outside the US do significantly worse than the benchmark group. An event is expected to lose 67,486 buys for every free fight broadcast on cable TV. The PPV price has a statistically significant positive coefficient, which is starkly contradictory to all neoclassical economic models. A higher number of bouts apparently draw a higher buy rate, regardless of the fact that the PPV broadcast only shows the main card. Lastly, variables with no statistically significant effect on buy rate include the *Ultimate Fighter* reality show tie in, the middleweight title, the lightweight title, and the constant term.

The conclusions of this regression are confusing and quite different than what we would expect. First, the positive coefficient of the PPV price variable makes no sense from neoclassical standpoint; higher prices should

dissuade potential customers, not attract them. The positive coefficient is almost certainly due to endogeneity, as the price of UFC PPVs has increased as the popularity of the sport has grown. Omitting the earlier half of the dataset would likely produce different, more sensible results. Second, the featherweight title has never been a big draw, so its extremely high coefficient doesn't pass the smell test. By the start of 2012, only two featherweight title bouts had occurred, both of which served as co-main events to the welterweight and lightweight titles, UFC 129 and UFC 136, respectively. The fact that the featherweight title was not the headlining bout, coupled by the tiny sample size, indicates that the featherweight title coefficient is wildly incorrect. Nevertheless, the positive effects of the heavyweight and light heavyweight titles are consistent with our hypotheses. Third, we remain unconvinced that *The Ultimate Fighter* has no significant effect on buy rate, since these UFC events are almost always the most heavily promoted. Despite its confusing results, Watanabe's paper pioneered the analysis of direct demand for the UFC and laid the groundwork for future study.

Scott Tainsky, Steven Salaga, and Carla Almeida Santos wrote a 2013 paper (Tainsky, Salaga & Santos, 2013) using the same dependent variable, but a slightly different set of independent variables. Their data spans from from UFC 33 in September 2001 to UFC 132 in July 2011, for a total of 93 observations. Their study's primary model was the following:

$$\begin{aligned} PPV \text{ buys} = & \beta_0 + \beta_1 TrendMonth + \beta_2 PostTUF + \beta_3 TrendMonth*PostTUF + \beta_4 HolidayWeekend + \beta_5 \\ & SuperBowlWeekend + \beta_6 MainTUF + \beta_7 MainBettingOdds + \beta_8 CoBettingOdds + \beta_9 \\ & MainTitleDefenses + \beta_{10} CoTitleDefenses + \beta_{11} CoTitleIndicator + \beta_{12} MainTitleWW + \beta_{13} \\ & MainTitleMW + \beta_{14} MainTitleLHW + \beta_{15} MainTitleHW + \beta_{16} DaysSinceLastUFC + \beta_{17} Stars \\ & + \beta_{18} NFLSub + \beta_{19} NCAASub + \beta_{20} MLBSub + \beta_{21} NBASub + \beta_{22} NHLSub + e \end{aligned}$$

TrendMonth is a monthly trend variable, starting at 1 in September 2001 and increasing one unit for each subsequent month. *PostTUF* is a dummy variable that indicates if an event took place after the inaugural season of *The Ultimate Fighter*. Then, there is a variable that interacts *TrendMonth* with *PostTUF*. *HolidayWeekend* and *SuperBowlWeekend* are dummies indicating scheduling on special weekends. *MainTUF* is an ordinal variable counting the number of main event fighters who have appeared on any season of *The Ultimate Fighter*. This is a novel way at measuring the effect of TUF; instead of solely accounting the coaches' match at the end of the season, this variable includes any fighter who has appeared on any season of the show as a coach or contestant, therefore having additional exposure. *MainBettingOdds* and *ComainBettingOdds* represent the difference in the pre-fight gambling odds between the fighters in the main and co-main events respectively; the higher variable's value, the higher the perception of a mismatch. In traditional sports economic theory, higher uncertainty of outcome draws more interest (Borland J. & Macdonald R., 2003), so the coefficients on these variables are expected to be negative. *MainTitleDefenses* and *CoTitleDefenses* represent the number of consecutive title defenses by a champion in the main and co-main events respectively. *CoTitleIndicator* is a dummy indicating if the co-main bout features a title fight at any weight class, meaning that the event would feature two title fights in one night. The four title dummy variables indicate if the main event featured a title fight at heavyweight, light heavyweight, middleweight, and welterweight. Strangely, the study omits the lightweight title dummy variable here, and we have no idea as to why. *DaysSinceLastUFC* counts the number of days since the last UFC event (PPV or non-PPV). *Stars* represents the number of "star" fighters on the main card, classified as such if a fighter is a current or former champion at any weight class. Lastly, *NFLSub*, *NCAASub*, *MLBSub*, *NBASub*, and *NHLSub* are dummy variables indicating if a UFC event was held during the regular season or playoffs of the NFL, NCAA

Demand for the Ultimate Fighting Championship: An Econometric Analysis of PPV Buy Rates

BCS Football, MLB, NBA, and NHL respectively. These variables measures for the effect of alternative sports substitutes on a UFC PPV buy rate.

Because the dependent variable is skewed right, the study estimates a generalized linear model using maximum likelihood optimization with robust standard errors. The r-squared was .6336, and the results of the full model regression are shown below:

Table 2 PPV Demand Using Maximum Likelihood Estimators

	Coefficient	Robust S.E.	z-statistic
TRENDMONTH	5659.23*	3173.39	1.78
POSTTUF	133427.50	153550	0.87
TREND*POSTTUF	-451.70	3523.25	-0.13
HOLIDAYWEEKEND	110895.20	81650.72	1.36
SBWEEKEND	55962.37	81133.99	0.69
MAINTUF	117957.50**	49795.39	2.37
MAINBETTINGODDS	-163.99**	72.81	-2.25
COBETTINGODDS	47.61	68.82	0.69
MAINTITLEDEFENSES	29303.78**	14056.89	2.08
COTITLEDEFENSES	5457.88	38528.90	0.14
COTITLEIND	99131.70	76958.26	1.29
MAINTITLEWW	232246.90***	65288.37	3.56
MAINTITLEMW	42797.76	88429.27	0.48
MAINTITLELHW	156961.20**	76617.16	2.05
MAINTITLEHW	304926***	97748.52	3.12
DAYSSINCELASTUFC	-1264.47	1266.92	-1.00
STARS	31046.44	20556.43	1.51
NFLSUB	-35584.83	62406.24	-0.57
NCAASUB	-5458.44	68642.21	-0.08
MLBSUB	14522.44	60659.61	0.24
NBASUB	26341.66	66259.09	0.40
NHLSUB	-48353.84	74238.60	-0.65
CONSTANT	-258396.40	177144.80	-1.46

Note 1: $R^2 = 0.6336$; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The *TrendMonth* variable is positive and significant, explaining that there is an average~5,500 increase in buy rate every month, ceteris paribus. The other trend and scheduling variables have no significant effect. It is also estimated that there is approximately a 118,000 increase in buy rate for each TUF alumnus in the main event bout. As expected, a larger difference in main event betting odds negatively affects the buy rate, albeit only slightly. The *stars* variable predicts that the buy rate increases by 31,000 per current/former champion on the card, but it is only statistically significant at the 13.1% level. Lastly, the alternative sports substitut variables all were statistically insignificant.

As for the title effects, the biggest draws are the heavyweight title (+305K), followed by the welterweight title (+232K), followed by the light heavyweight title (+157K); the middleweight title is statistically insignificant. The *MainTitleDefenses* variable was positive and significant, meaning that the buy rate rises as the main event

Demand for the Ultimate Fighting Championship: An Econometric Analysis of PPV Buy Rates

champion defeats more challengers. This variable cleverly accounts for the degree of dominance of a champion, and hints that people are more willing to pay to see a champion who has proven his dominance. The UFC's biggest draws are frequently its best fighters (who are often dominant champions), so this variable makes sense. The *CoTitleInd* variable suggested that a second title on the card raises buy rates by 99,000, but the variable was significant at only the 19.7% level.

While Watanabe's regression had a slightly higher coefficient of determination (0.6631 to 0.6336), we believe Tainsky's model better estimated the true effects of the determinants on PPV buy rate. Watanabe's results had wildly confusing coefficients on the *PPV price* and *Featherweight Title* variables. Additionally, the *Ultimate Fighter* show tie-in had no effect in Watanabe's regression, but was strongly positive and significant in Tainsky's. On the other hand, the *HolidayWeekend* variable was negative and significant in Watanabe's model, but insignificant in Tainsky's. Tainsky also included more variables that seemed relevant to affecting PPV buy rate, such as differentiating between a title in the main versus co-main event, the number of consecutive title defenses by a champion, the number of stars on the card, and alternative viewing substitutes.

Watanabe's 2013 follow-up to his first paper (Watanabe, 2013) differed only slightly from his original results. There are 80 observations of events held from 2001 to 2011, one fewer observation than in his previous study. His model is the following:

$$\begin{aligned} PPV \text{ buys} = & \beta_0 + \beta_1 PPV \text{ Price} + \beta_2 Population + \beta_3 GDP \text{ per capita} + \beta_4 Recession \text{ dummy} + \beta_5 Time \\ & trend + \beta_6 Time \text{ trend squared} + \beta_7 Weekend + \beta_8 Holiday + \beta_9 \text{ days from previous event} + \beta_{10} \\ & \text{number of fights on cable} + \beta_{11} TUF \text{ reality tie-in} + \beta_{12} flyweight \text{ champ} + \beta_{13} bantamweight \\ & \text{champ} + \beta_{14} featherweight \text{ champ} + \beta_{15} welterweight \text{ champ} + \beta_{16} lightweight \text{ champ} + \beta_{17} \\ & \text{middleweight champ} + \beta_{18} light \text{ heavyweight champ} + \beta_{19} heavyweight \text{ champ} + \beta_{20} \text{ number} \\ & \text{of bouts} + \beta_{21} \text{ internet streaming} + e \end{aligned}$$

The differences between this model and the 2012 study's model one are quite small. First, Watanabe includes a time trend and time trend squared variable. Second, he includes dummy variables for the bantamweight and featherweight titles. All other variables are identical to the previous study. He obtained an r-squared value of 0.6248. The full results of his regression are on the below chart:

The results of this regression fare significantly than the previous paper. The title variables indicate that the biggest draws were heavyweight (+272K), light heavyweight (+177K), and welterweight (+151K). In stark contrast to the last study, the featherweight title's coefficient was -375,000, hinting that events featuring the featherweight title did far worse than ones without it. The lightweight title coefficient was positive but only significant at the 17.1% level. The middleweight and bantamweight titles were statistically insignificant, and the flyweight title had no observations. Only other significant variables were the weekend dummy and the number of fights aired free on cable, both of which were negative. The weekend variable's negative coefficient is especially strange because there are no PPV events since 2005 that were not held on a Saturday night. The coefficient on the number of cable fights is again negative, suggesting that more preliminary fights aired free on cable TV actually negatively affects the buy rate. While we are comfortable accepting the title effects, the last two variables' coefficients do not make sense to us and we would be surprised if they represented the true effect.

Demand for the Ultimate Fighting Championship: An Econometric Analysis of PPV Buy Rates

Table 3 PPV Demand using Tainsky's Regression

Dependent Variable is UFC Pay-per-view Buy rate				
	Coeff.	Std Err.	t-stat	P > t
PPV Price	30071	24759	1.21	0.23
Population (Millions)	125	96866	0.00	0.999
GDPAdj	71.00	157	0.45	0.653
Recession	-76258	119450	-0.64	0.526
Time	70461	334861	0.21	0.834
Time Squared	-3903	99512	-0.39	0.696
Weekend	-238813	103297	-2.31**	0.025
Holiday	-118923	152674	-0.78	0.439
Days From Prev Event	-1588	1888	-0.84	0.404
Fight Number on Cable	-67750	31825	-2.13**	0.038
Reality	0	(omitted)		0.63
Flyweight Champ	0	(omitted)		
Bantam Champ	-109201	133864	-0.82	0.418
Feather Champ	-374998	101117	-3.71***	0.000
Welter Champ	151302	88767	1.70*	0.094
Lightweight Champ	92194	66530	1.39	0.171
Middleweight Champ	-29714	67863	-0.44	0.663
Light heavy Champ	176568	70714	2.50**	0.016
Heavyweight Champ	272283	79800	3.41***	0.001
Bouts	39740	40243	0.99	0.328
Internet Streaming	-18431	154067	-0.12	0.905
Constant	-2448153	2.69E+07	-0.09	0.928

5. Methodology

5.1 Data Collection

Unfortunately, the datasets used by Watanabe and Tainsky in their research papers was unattainable; thus, this study uses a dataset built from scratch. The dependent variable data comes primarily from mmapayout.com, which compiles information from industry insider Dave Meltzer of the *Wrestling Observer Newsletter*.³ The data on independent variables come from a variety of sources, including UFC.com, sherdog.com, mmafighting.com, and a number of other websites, cross-checked against each other to ensure accuracy. The GDP per capita data comes from the World Bank website,⁴ and the population data comes from the US Census website.⁵

The dataset records 105 observations, starting with UFC 57 in February 2006 and ending with UFC 170 in February 2014. The only PPV event omission was UFC 151, the only canceled event in UFC history. PPV numbers prior to UFC 57 were not available on mmapayout.com, and though likely findable, are not especially important to this study. Now that the UFC has established itself as a staple of the sports world, growth has slowed significantly, ameliorating the need to account for endogenous growth of the sport. The focus of this study is on the UFC's buy rates after its surge into mainstream popularity, not during it.

³ "Blue Book: Pay-Per-View", *MMApayout.com*.

⁴ "GDP per Capita (Current US\$)", *World Bank*.

⁵ "U.S. and World Population Clock", *US Census*.

Demand for the Ultimate Fighting Championship: An Econometric Analysis of PPV Buy Rates

5.2 Model & Variables

To estimate direct demand for the UFC in the form of PPV buy rates, we employed two slightly different models, which will be analyzed using ordinary least squares regression analysis. The two equations, Model 1 and Model 2, are:

Model 1

$$PPV\ buys = \beta_0 + \beta_1 GDP\ Per\ Capita + \beta_2 Population + \beta_3 International + \beta_4 TUF + \beta_5 PctFree + \beta_6 HWTitle + \beta_7 LHWTitle + \beta_8 MWTitle + \beta_9 WWTitle + \beta_{10} LWTitle + \beta_{11} FWTitle + \beta_{12} BWTitle + \beta_{13} FLWTitle + \beta_{14} WomensTitle + \beta_{15} WWTitleCo + \beta_{16} LWTitleCo + \beta_{17} FWTitleCo + \beta_{18} WomensTitleCo + (\beta_i FighterID\ Dummy) + \varepsilon$$

Model 2

$$PPV\ buys = \beta_0 + \beta_1 GDP\ Per\ Capita + \beta_2 Population + \beta_3 International + \beta_4 TUF + \beta_5 PctFree + \beta_6 HWTitle + \beta_7 LHWTitle + \beta_8 MWTitle + \beta_9 WWTitle + \beta_{10} LWTitle + \beta_{11} FWTitle + \beta_{12} BWTitle + \beta_{13} FLWTitle + \beta_{14} WomensTitle + \beta_{15} Titles + \beta_{15} Supercard + (\beta_i FighterID\ Dummy)$$

The difference lies in interpreting the data when there is more than one title fight on the card. Model 1 specifies which title is being contested in the main event versus the co-main event; the “-co” suffix indicates the co-main event title bout. Model 2 accounts for all titles contested in the event without distinguishing which is the main or co-main event. Additionally, the *titles* variable takes the value 1 to denote that the event features two title fights. The *Supercard* variable takes the value of 1 for three specific UFC events (UFC 100, 112, and 168) that featured multiple particularly high-draw title fights. The criterion for *supercard* is that the event must feature 2 title fights, neither of which is a men’s title fight at featherweight or lighter division. This has only happened three times in the UFC, each of which was vigorously promoted as a “supercard”. An explanation of the independent variables and their meanings in each model can be found below:

Table 4 An Explanation of the Independent Variables and Their Meanings in Each Model

Variable	Description
gdppc	GDP per capita of the US the year the event occurred
population	Population of the US the year the event occurred
international	= 1 if event occurs outside of the US or Canada
tuf	= 1 if main card features <i>Ultimate Fighter</i> coaches fight
pctfree	Percentage of UFC events free on cable TV that year
hwtitle	= 1 if main event is heavyweight (265) title
lhwttitle	= 1 if main event is light heavyweight (205) title
mwtitle	= 1 if main event is middleweight (185) title
Model 1:	
wwtitle	= 1 if main event is welterweight (170) title
lwtitle	= 1 if main event is lightweight (155) title
fwtitle	= 1 if main event is featherweight (145) title
bwttitle	= 1 if main event is bantamweight (135) title
flwttitle	= 1 if main event is flyweight (125) title
womenstitle	= 1 if main event is women’s bantamweight (135) title
wwtitleco	= 1 if co-main event is WW (170) title
lwtitleco	= 1 if co-main event is LW (155) title
fwtitleco	= 1 if co-main event is FW (145) title

(Table 4 to be continued)

Demand for the Ultimate Fighting Championship: An Econometric Analysis of PPV Buy Rates

(Table 4 continued)

flwtitleco	= 1 if co-main event is FLW (125) title
[fighterID]	= 1 if [fighter] fights in main event
Model 2:	
wwtitle	= 1 if main or co-main event is WW (170) title
lwtitle	= 1 if main or co-main event is LW (155) title
fwtitle	= 1 if main or co-main event is FW (145) title
bwtitle	= 1 if main or co-main event is BW (135) title
flwtitle	= 1 if main or co-main event is FLW (125) title
womenstitle	= 1 if main or co-main event is women's BW (135) title
titles	= 1 if event features 2 titles
supercard	= 1 if event features 2 titles, neither of which are FW, BW, or FLW
[fighterID]	= 1 if [fighter] fights in main or co-main

6. Results

For differing purposes, we ran three regressions of each both Model 1 and Model 2. The three different regressions were: (a) a model omitting fighter ID variables, (b) the full model including fighter ID variables, (c) full model since 2008, reduced to include only significant variables. The results of regressions 1A and 2A are the following:

Regression 1A

Source	SS	df	MS	Number of obs = 103		
				F(17, 85) = 6.07		
Model	3.5259e+12	17	2.0741e+11	Prob > F = 0.0000		
Residual	2.9050e+12	85	3.4177e+10	R-squared = 0.5483		
				Adj R-squared = 0.4579		
Total	6.4309e+12	102	6.3048e+10	Root MSE = 1.8e+05		
buys	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
gdppc	-68.4	41.39133	-1.65	0.102	-150.7585	13.83555
population	16307.8	9099.711	1.79	0.077	-1784.772	34400.56
international	-137499.1	61233.72	-2.25	0.027	-259248.2	-15750.08
tuf	203653.2	75135.19	2.71	0.008	54264.34	353042.1
pectfree	394186.3	637095.8	0.62	0.538	-872530.9	1660904
lwtitle	196410.9	64410.42	3.05	0.003	68345.71	324476.1
lhwttitle	133791.0	58836.13	2.27	0.025	16808.99	250773
mwtitle	89740.6	61995.56	1.45	0.151	-33523.14	213004.4
wwtitle	223910.6	63480.39	3.53	0.001	97694.59	350126.6
lwtitle	-12023.3	61724.2	-0.19	0.846	-134747.6	110700.9
fwtitle	-52073.5	117721.9	-0.44	0.659	-286136.2	181989.2
bwtitle	-82905.4	189332.2	-0.44	0.663	-459348.6	293537.7
flwtitle	0	(omitted)				
womenstitle	66292.5	190442.8	0.35	0.729	-312358.8	444943.9
wwtitleco	702643.0	208255.4	3.37	0.001	288575.6	1116711
lwtitleco	92065.0	202924.4	0.45	0.651	-311403.1	495533.1
fwtitleco	3650.9	139962.9	0.03	0.979	-274632.7	281934.6
womenstitleco	347898.7	209893.4	1.66	0.101	-69425.69	765223
_cons	-1426149.0	1407674	-1.01	0.314	-4224981	1372684

1044

Demand for the Ultimate Fighting Championship: An Econometric Analysis of PPV Buy Rates

Regression 2A

Source	SS	df	MS	Number of obs = 103		
Model	3.5259e+12	16	2.1837e+11	F(16, 86) = 6.39		
Residual	2.9371e+12	86	3.4152e+10	Prob > F = 0.0000		
				R-squared = 0.5433		
				Adj R-squared = 0.4583		
Total	6.4309e+12	102	6.3048e+10	Root MSE = 1.8e+05		

buys	Coef.	Std. Err.	t	P > t	[95% Conf. Interval]	
gdppc	-73.6	41.37615	-1.78	0.079	-155.9242	8.581954
population	17377.9	9087.469	1.91	0.059	-687.3093	35443.27
international	-145820.8	60018.75	-2.43	0.017	-265134.2	-26507.5
tuf	222985.2	72741.6	3.07	0.003	78379.69	367590.7
pctfree	506547.0	644542	0.79	0.434	-774760	1787854
hwtitle	202730.5	63627.87	3.19	0.002	76242.45	329218.5
lhwttitle	130426.5	59699.04	2.18	0.032	11748.75	249104.3
mwtitle	75529.8	61281.42	1.23	0.221	-46293.6	197353.2
wwtitle	227028.8	63184.55	3.59	0.001	101422.1	352635.5
lwtitle	-21552.3	60525.07	-0.36	0.723	-141872.2	98767.51
fwtitle	-93854.3	107640.4	-0.87	0.386	-307836.3	120127.6
bwtitle	-83865.7	189259.9	-0.44	0.659	-460101.9	292370.5
flwtitle	-125057.3	251675.5	-0.50	0.621	-625371.7	375257
womenstitle	54700.0	155124.9	0.35	v	-253678	363078.2
titles	52823.2	149785.5	0.35	0.725	-244940.4	350586.9
supercard	234146.6	202057.7	1.16	0.250	-167530.7	635823.9
_cons	-1544684.0	1405395	-1.10	0.275	-4338517	1249149

First, the macroeconomic variables' coefficients surprised us. While it makes sense demand increases with a larger addressable audience, one would expect demand to rise with GDP per capita as well; however, the coefficient on GDP per capita is negative in both models. International events are expected to do significantly worse than ones held in the US or Canada. This could be due to the UFC scheduling generally lower quality cards on their international events. As expected, the *Ultimate Fighter* reality tie in was strongly positive and statistically significant. The percentage of free events had no significant effect.

In regards to the title effects, welterweight (+223K/+227K), heavyweight (+196K/+202K), and light heavyweight (+134K/+130K) have the largest positive effects on buy rate. While the middleweight title too has a positive coefficient, it is not statistically significant at a legitimate level in either regression. In regression 1A, the welterweight title and women's titles have significant effects as co-main events. However, these isolated incidents occurred at UFC 100 and 168, two of the promotion's biggest shows ever, so while the positive coefficients do make sense, they should be taken with a grain of salt. Either of those bouts could easily headline an event of their own, and their status as the co-main event fight indicates that the UFC was putting on a "supercard", which brings us to regression 2A. Neither the *titles* nor *supercard* variables were significant, but the rest of the coefficients makes sense. This would hint that putting a second title fight on a card does not necessarily improve the buy rate; it has to be a high-demand fight on its own to affect the buy rate as the co-main event.

Our r-squared values are .5483 and .5433 in regressions 1A and 2A respectively, lower than those in Tainsky's (0.6336) and Watanabe's (0.6248) papers, but the coefficients on the variables are very similar. All three studies agree that the heavyweight, welterweight, and light heavyweight titles are the biggest draws; that

international events do worse than ones held in the US; and that *The Ultimate Fighter* has a does positively effect buy rate; all ceteris paribus.

The next set of regressions adds the fighter ID variables. Regression 1B had an r-squared value of 0.8328, and regression 2B had an r-squared at 0.7867. The full results of these regressions can be viewed in the appendix. The main takeaway from these regressions is that the effects of the titles diminish greatly after controlling for the identities of the fighters in those title fights. For example, while Georges St. Pierre welterweight champion of the UFC, the welterweight title had a hugely positive coefficient. However, the coefficient's value was such not because of the importance of the welterweight belt, but because of the drawing power of St. Pierre. After the addition of the fighter ID control variables, only the heavyweight title still has a statistically significant positive coefficient in both Model 1 and Model 2. The welterweight title's effect has been correctly reapportioned to Georges St. Pierre, and the women's title's effect has been reapportioned to Ronda Rousey.

Consistent with regressions 1A and 1B, the GDP per capita coefficient stays negative and the population coefficient remains positive. The *Ultimate Fighter* dummy coefficient is again significant and positive. The international variable, however, has gone from significant and negative to statistically insignificant, demonstrating that the location of the event matters not after controlling for the fighters on the card. This indicates that the UFC schedules a weaker card when holding a UFC event abroad, hinting that they believe demand for live attendance is more inelastic abroad than it is in the United States. The coefficient on the percentage of free fights is strangely negative, predicting that the higher the ratio of free to PPV UFC events, the higher the buy rate will be for the PPV events.

As for the drawing power of the fighters themselves, the 5 individuals with the highest positive coefficient across both models are: Brock Lesnar (HW), Georges St. Pierre (WW), Anderson Silva (MW), BJ Penn (LW), and Ronda Rousey (Women's BW). Exactly what makes these fighters particularly high draws is a whole different discussion entirely, but the fact remains that they possess a certain flair that has proven to draw abnormally high interest.

Regressions 1C and 2C are identical to 1B and 2B respectively, except the observations begin in 2008. The reason for this is twofold—first, to remove the factor of latent growth of the UFC from 2006 and 2007, and second, to use a more updated roster, so fighters who are no longer relevant don't factor in. After being reduced to include only statistically significant variables, the r-squared values are 0.8466 for 3A and 0.8023 for 3B. The five aforementioned fighters continue to have statistically significant positive coefficients. Other fighters with high drawing power include Quinton “Rampage” Jackson (LHW), Jon Jones (LHW), Shogun Rua (LHW) Rashad Evans (LHW), Nick Diaz (WW), Chael Sonnen (MW), Lyoto Machida (MW), and Antonio Rodrigo Nogueira (HW). Cain Velasquez, the current heavyweight champion, had the only statistically significant negative coefficient. This is likely due to the unmatched drawing power of previous heavyweight champion Brock Lesnar and the resulting inflation of the heavyweight title coefficient. Lastly, the coefficients on GDP per capita, population, and percent free fights remain the same as in regressions 1B and 2B.

7. Conclusions

The results of our study are not good news for the UFC as a company. The most important takeaway is that the identities of the fighters competing matter more than any title they would be competing for. Thus, when it comes to generating abnormally high PPV buy rates, the fighter has more drawing power than the brand. This

conclusion could be used as an argument for fighters to get a larger percentage of the PPV revenue, since the fighters themselves, not the UFC titles, are what truly drive PPV buy rates. That is not to say that titles have no effect on buy rate. They certainly do, and almost sure contribute to a higher buy rate if a popular fighter is in a title fight. What they don't do, however, is turn an unpopular fighter into a draw simply because he is fighting for the title.

That being said, the UFC heavyweight championship appears to generate more interest as a title than the individuals who fight for it. It seems that viewers are always interested in the heavyweight championship, regardless of who is fighting for that title. The light heavyweight title comes in second; after that, however, there is no clear third. The longtime welterweight champion Georges St. Pierre just recently vacated his title on December of 2013, so the near future will determine whether or not the welterweight title continues to be a draw without him. The same goes for recently dethroned middleweight champion Anderson Silva. There is potential that the legacies left behind by these superstar champions translate into a lingering interest for that specific title, but that is wildly speculative. Lastly, title fights at male weight classes lighter than 155 pounds generate little to no additional interest in a UFC event.

While originally it appeared that international events contribute to lower buy rates than events held in the US and Canada, this was revealed to be false after controlling for the fighters on the card. As mentioned previously, the UFC elects to put on weaker cards for its international events, possibly due to the perception that international demand depends more on the UFC brand and less on the fighters. More likely, however, is that the UFC chooses fighters that would have a bigger impact overseas than they would in the United States. For example, Denis Siver is a middling featherweight fighter of German nationality, so the UFC put him on the main card when it held an event in Germany. Similar strategies have been used for the UFC's foray into Brazil, Australia, Sweden,

Scheduling variables seem to have no significant effects on UFC buy rates, as long as the UFC continues to air events at 10:00 PM EST on Saturday nights. While we did not include many scheduling variables in our own models, the results from literature induce us to believe that minor variations in scheduling do not significantly affect direct demand for UFC. Surprisingly, the model predicts that broadcasting more free UFC events would contribute to higher PPV buy rates.

In conclusion, the UFC should be most concerned with creating and promoting superstars, as they are the main causes of high buy rates. Instead of heralding their champions as must-see fighters, they should focus on identify the fighters who have demonstrated drawing power and spend efforts promoting them. This is much easier said than done, as superstar fighters do not come easily or often. Additionally, as a sports league as well as a promotion company, the UFC has the obligation of treating their fighters equally, not accounting for how popular the fighter may be.

8. Further Discussion

Though we are comfortable with the conclusions of our model, there is always room for improvement. Several omitted variables exist that are ideally incorporated into the model, including the number of top 5 ranked fighters on the card, the differences in betting odds between the fighters, whether or not the main event has been changed due to injury, the number of consecutive title defenses by a champion, and more. Interaction of fighter ID variables with title fights could also prove insightful. In an ideal world, there is a dummy for every fighter's appearance in the main event, co-main event, or other main card bout. Much of these variables could be found by

Demand for the Ultimate Fighting Championship: An Econometric Analysis of PPV Buy Rates

intensively scouring the internet, but time and resources were insufficient to complete such a task.

This study provides a framework by which the UFC can analyze the determinants of its PPV buy rates, a form of direct demand for the UFC. Accurately deriving demand is incredibly important in the UFC's goal to maximize revenue and further grow the sport. Given that the endogenous growth of the UFC has slowed greatly, specific event characteristics have emerged as the primary factors that govern the buy rate. Using a combination of empirical regression analysis and industry expertise, the UFC can more accurately estimate the buy rates of its upcoming events.

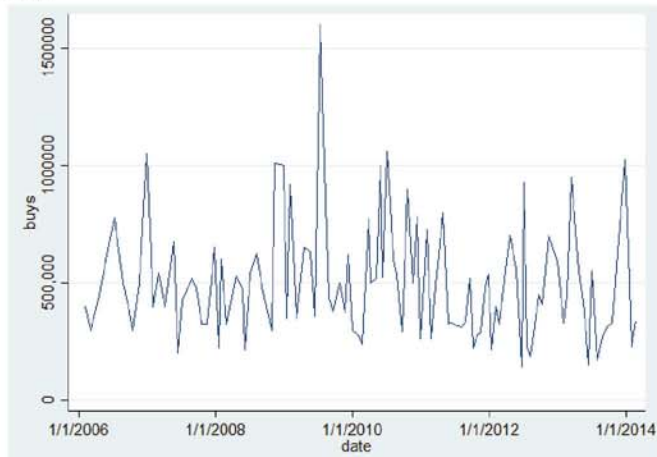
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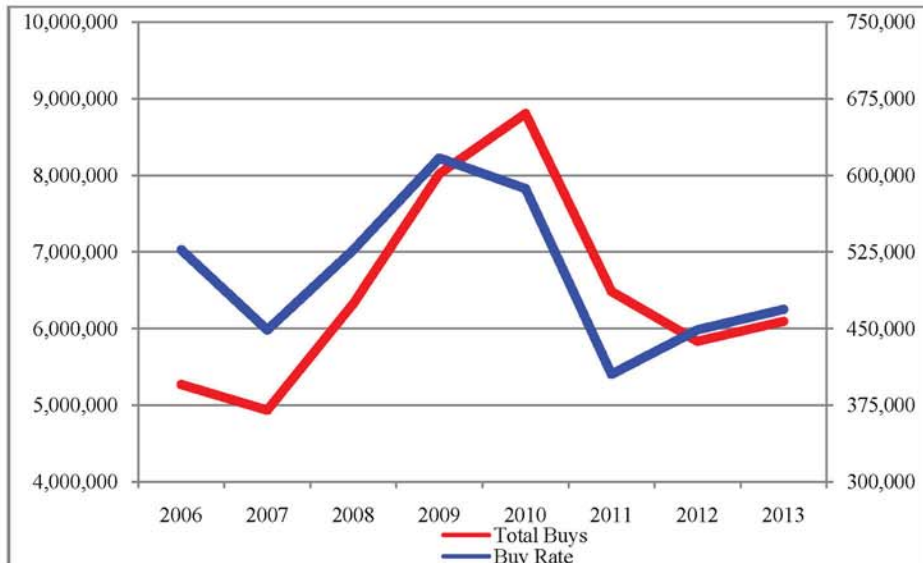
Demand for the Ultimate Fighting Championship: An Econometric Analysis of PPV Buy Rates

Appendix

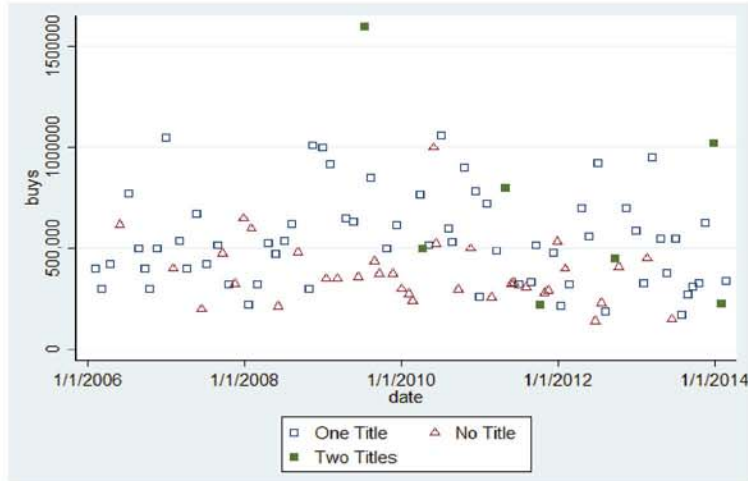
PPV Buy Rates Breakdown



Year	PPVs	Avg Buys	% Change Average	Avg Rank	StDev	Min	Max	Total Buys	% Change Total	Total Tank
2006	10	527000	-	4	233538	300000	1050000	5270000		7
2007	11	448636	-14.87%	7	142690	200000	675000	4935000	-6.36%	8
2008	12	527083	+17.49%	3	262492	215000	1010000	6325000	+28.17%	4
2009	13	616923	+17.04%	1	351944	350000	1600000	8020000	+26.80%	2
2010	15	587000	-4.85%	2	264128	240000	1060000	8805000	+9.79%	1
2011	16	405313	-30.95%	8	170855	225000	800000	6485000	-26.35%	3
2012	13	448846	+10.74%	6	236178	150000	925000	5835001	-10.02%	6
2013	13	468846	+4.46%	5	271187	150000	1025000	6095000	+4.46%	5
2014	2	285000	-	9	77781	230000	340000	570000	-	-



Demand for the Ultimate Fighting Championship: An Econometric Analysis of PPV Buy Rates



Data Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
buys	105	498476.2	250574.5	140000	1600000
gdppc	105	49115.11	1858.383	46444	51749
population	105	308.4185	5.617441	298.4	316.14
pctfree	105	0.430011	0.0707432	0.35	0.5806452
title	105	0.6761905	0.4701726	0	1
titles	105	0.0666667	0.2506402	0	1
internatio~l	105	0.1333333	0.341565	0	1
tuf	105	0.0857143	0.2812843	0	1
hwtitle	105	0.1238095	0.3309438	0	1
lhwttitle	105	0.152381	0.3611135	0	1
mwtitle	105	0.1333333	0.341565	0	1
wwtitle	105	0.1142857	0.3196839	0	1
lwtitle	105	0.1142857	0.3196839	0	1
fwtitle	105	0.0285714	0.1673977	0	1
bwtitle	105	0.0190476	0.137348	0	1
flwtitle	105	0	0	0	0
womenstitle	105	0.0190476	0.137348	0	1
wwtitleco	105	0.0095238	0.09759	0	1
lwtitleco	105	0.0095238	0.09759	0	1
fwtitleco	105	0.0285714	0.1673977	0	1
flwtitleco	105	0.0095238	0.09759	0	1
womenstitle~o	105	0.0095238	0.09759	0	1

Demand for the Ultimate Fighting Championship: An Econometric Analysis of PPV Buy Rates

Regression 1A

Source	SS	df	MS	Number of obs = 103		
Model	3.5259e+12	17	2.0741e+11	F(17,85) = 6.07		
Residual	2.9050e+12	85	3.4177e+10	Prob > F = 0.0000		
				R-squared = 0.5483		
				Adj R-squared = 0.4579		
Total	6.4309e+12	102	6.3048e+10	Root MSE = 1.8e+05		
buys	Coef.	Std. Err.	t	P > t	[95% Conf. Interval]	
gdppc	-68.4	41.39133	-1.65	0.102	-150.7585	13.83555
population	16307.8	9099.711	1.79	0.077	-1784.772	34400.56
international	-137499.1	61233.72	-2.25	0.027	-259248.2	-15750.08
tuf	203653.2	75135.19	2.71	0.008	54264.34	353042.1
petfree	394186.3	637095.8	0.62	0.538	-872530.9	1660904
hwtitle	196410.9	64410.42	3.05	0.003	68345.71	324476.1
lhwttitle	133791.0	58836.13	2.27	0.025	16808.99	250773
mwtitle	89740.6	61995.56	1.45	0.151	-33523.14	213004.4
wwtitle	223910.6	63480.39	3.53	0.001	97694.59	350126.6
lwtitle	-12023.3	61724.2	-0.19	0.846	-134747.6	110700.9
fwtitle	-52073.5	117721.9	-0.44	0.659	-286136.2	181989.2
bwtitle	-82905.4	189332.2	-0.44	0.663	-459348.6	293537.7
flwtitle	0	(omitted)				
womenstitle	66292.5	190442.8	0.35	0.729	-312358.8	444943.9
wwtitleco	702643.0	208255.4	3.37	0.001	288575.6	1116711
lwtitleco	92065.0	202924.4	0.45	0.651	-311403.1	495533.1
fwtitleco	3650.9	139962.9	0.03	0.979	-274632.7	281934.6
womenstitleco	347898.7	209893.4	1.66	0.101	-69425.69	765223
_cons	-1426149.0	1407674	-1.01	0.314	-4224981	1372684

Regression 2A

Source	SS	df	MS	Number of obs = 103		
Model	3.4938e+12	16	2.1837e+11	F(16, 86) = 6.39		
Residual	2.9371e+12	86	3.4152e+10	Prob > F = 0.0000		
				R-squared = 0.5433		
				Adj R-squared = 0.4583		
Total	6.4309e+12	102	6.3048e+10	Root MSE = 1.8e+05		
buys	Coef.	Std. Err.	t	P > t	[95% Conf. Interval]	
gdppc	-73.67111	41.37615	-1.78	0.079	-155.9242	8.581954
population	17377.98	9087.469	1.91	0.059	-687.3093	35443.27
international	-145820.8	60018.75	-2.43	0.017	-265134.2	-26507.5
tuf	222985.2	72741.6	3.07	0.003	78379.69	367590.7
petfree	506547	644542	0.79	0.434	-774760	1787854
hwtitle	202730.5	63627.87	3.19	0.002	76242.45	329218.5
lhwttitle	130426.5	59699.04	2.18	0.032	11748.75	249104.3
mwtitle	75529.83	61281.42	1.23	0.221	-46293.6	197353.2
wwtitle	227028.8	63184.55	3.59	0.001	101422.1	352635.5
lwtitle	-21552.34	60525.07	-0.36	0.723	-141872.2	98767.51
fwtitle	-93854.37	107640.4	-0.87	0.386	-307836.3	120127.6
bwtitle	-83865.7	189259.9	-0.44	0.659	-460101.9	292370.5
flwtitle	-125057.3	251675.5	-0.50	0.621	-625371.7	375257
womenstitle	54700.08	155124.9	0.35	0.725	-253678	363078.2
titles	52823.24	149785.5	0.35	0.725	-244940.4	350586.9
supercard	234146.6	202057.7	1.16	0.250	-167530.7	635823.9
_cons	-1544684	1405395	-1.10	0.275	-4338517	1249149

1051

Demand for the Ultimate Fighting Championship: An Econometric Analysis of PPV Buy Rates

Regression 1B – Full Model

Source	SS	df	MS	Number of obs = 103		
Model	5.0849e+12	49	1.0377e+11	F(49, 53) = 4.09		
Residual	1.3461e+12	53	2.5397e+10	Prob > F = 0.0000		
				R-squared = 0.7907		
				Adj R-squared = 0.5972		
Total	6.4309e+12	102	6.3048e+10	Root MSE = 1.6e+05		
buys	Coef.	Std. Err.	t	P > t	[95% Conf. Interval]	
gdppc	-129.779	45.51742	-2.85	0.006	-221.0754	-38.48262
population	26014.14	10129.35	2.57	0.013	5697.23	46331.06
internatio~l	-23022.55	67545.72	-0.34	0.735	-158502.1	112457
tuf	210285.7	77344.8	2.72	0.009	55151.64	365419.7
pctfree	1857270	798529.6	2.33	0.024	255622.3	3458917
hwtitle	278679.7	100285.2	2.78	0.008	77533.01	479826.3
lhwttitle	90337.91	85512.42	1.06	0.296	-81178.27	261854.1
mwtitle	11745.86	98508.08	0.12	0.906	-185836.3	209328.1
wwtitle	-9572.237	151470.8	-0.06	0.950	-313384.2	294239.7
lwtitle	35334.2	89154.79	0.40	0.693	-143487.7	214156.1
fwtitle	-90913.24	189478.8	-0.48	0.633	-470959.6	289133.2
bwtitle	225390.4	241405.5	0.93	0.355	-258807.7	709588.6
flwttitle	0	(omitted)				
womenstitle	212312.2	179101.7	1.19	0.241	-146920.4	571544.8
wwtitleco	294676.5	224114.3	1.31	0.194	-154839.7	744192.8
lwtitleco	41830.94	182978.6	0.23	0.820	-325177.7	408839.5
fwtitleco	99465.08	135789.8	0.73	0.467	-172894.8	371825
flwttitleco	-210543.9	220173.2	-0.96	0.343	-652155.5	231067.6
womenstitl~o	364548.4	197762.4	1.84	0.071	-32112.74	761209.6
liddell	182182.4	78240.78	2.33	0.024	25251.27	339113.5
couture	66888.18	79965.42	0.84	0.407	-93502.14	227278.5
ortiz	102161.4	96161.66	1.06	0.293	-90714.44	295037.3
hughes	9281.918	102561.6	0.09	0.928	-196430.6	214994.4
gsp	360040.8	145754.7	2.47	0.017	67693.88	652387.7
gspco	0	(omitted)				
penn	155970	83616.51	1.87	0.068	-11743.49	323683.5
pennco	0	(omitted)				
rampage	165727.5	79877.26	2.07	0.043	5514.031	325941
asilva	200732.3	95224.26	2.11	0.040	9736.605	391728
jonjones	61493.01	103711.3	0.59	0.556	-146525.4	269511.5
lesnar	384517.6	88163.85	4.36	0.000	207683.4	561351.9
jds	41260.2	130079.7	0.32	0.752	-219646.5	302167
velasquez	-139334.3	130021.7	-1.07	0.289	-400124.8	121456.1
rousey	0	(omitted)				
rouseyco	0	(omitted)				
aldo	121592.6	211417.6	0.58	0.568	-302457.5	545642.7
aldoco	0	(omitted)				
faber	-98935.78	189145.9	-0.52	0.603	-478314.5	280442.9
shogun	101502.8	107074.1	0.95	0.347	-113260.6	316266.2
dhenderson	-48850.1	92333.84	-0.53	0.599	-234048.3	136348.1
evans	142287.6	73044.46	1.95	0.057	-4221.003	288796.3

1052

Demand for the Ultimate Fighting Championship: An Econometric Analysis of PPV Buy Rates

franklin	-59386.28	88482.48	-0.67	0.505	-236859.7	118087.1
belfort	179777.2	130954.4	1.37	0.176	-82884	442438.5
bisping	1284.667	185546.2	0.01	0.995	-370873.9	373443.3
wsilva	-26455.41	128137.2	-0.21	0.837	-283466	230555.2
sonnen	150863.4	114621.4	1.32	0.194	-79038.13	380764.9
barao	0	(omitted)				
nickdiaz	127025	115446.4	1.10	0.276	-104531.1	358581.2
condit	-17682.58	146541.4	-0.12	0.904	-311607.4	276242.3
edgar	-13711.78	99316.01	-0.14	0.891	-212914.5	185490.9
edgarco	0	(omitted)				
bhenderson	-55371.94	140636.5	-0.39	0.695	-337453.1	226709.2
mir	99525.18	104320.9	0.95	0.344	-109716.1	308766.4
machida	61106.33	99055.89	0.62	0.540	-137574.6	259787.3
serra	-62678.51	140121.5	-0.45	0.656	-343726.7	218369.7
nogueira	145872.5	120746.2	1.21	0.232	-96313.65	388058.7
sylvia	-186513.9	110448.6	-1.69	0.097	-408045.7	35017.92
_cons	-2199125	1959353	-1.12	0.267	-6129089	1730839

Regression 1B – Reduced to include only significant variables

Source	SS	df	MS	Number of obs = 82		
Model	4.7445e+12	17	2.7909e+11	F(17, 64) = 18.75		
Residual	9.5246e+11	64	1.4882e+10	Prob > F = 0.0000		
				R-squared = 0.8328		
				Adj R-squared = 0.7884		
Total	5.6970e+12	81	7.0333e+10	Root MSE = 1.2e+05		
buys	Coef.	Std. Err.	t	P > t	[95% Conf. Interval]	
gdppc	-137.773	31.40497	-4.39	0.000	-200.5117	-75.03442
population	31841.08	8432.82	3.78	0.000	14994.59	48687.58
pctfree	1533824	479933.2	3.20	0.002	575046.8	2492600
tuf	282398.7	54316.69	5.20	0.000	173888.7	390908.8
hwtitle	593383.7	92455.31	6.42	0.000	408683	778084.4
wwtitle	422267.8	46742.54	9.03	0.000	328888.8	515646.7
womenstitle	218216.6	126328.4	1.73	0.089	-34153.43	470586.7
womenstitleco	238012.7	142822	1.67	0.101	-47306.93	523332.4
penn	172395.5	50467.04	3.42	0.001	71576	273215
rampage	113558	57055.83	1.99	0.051	-424.0732	227540.2
asilva	272805.2	43210.95	6.31	0.000	186481.4	359129
jonjones	174221.6	49427.29	3.52	0.001	75479.27	272964
lesnar	249024.6	69943.92	3.56	0.001	109295.5	388753.6
velasquez	-344556.3	91671.93	-3.76	0.000	-527692	-161420.6
evans	171948.5	48846.06	3.52	0.001	74367.29	269529.7
machida	134140.7	61900.94	2.17	0.034	10479.35	257802
nogueira	238706.2	77277.18	3.09	0.003	84327.32	393085.2
_cons	-3471751	1776964	-1.95	0.055	-7021644	78141.49

Regression 2B – Full Model

Source	SS	df	MS	Number of obs = 103		
Model	5.0594e+12	47	1.0765e+11	F(47, 55) = 4.32		
Residual	1.3716e+12	55	2.4938e+10	Prob > F = 0.0000		
				R-squared = 0.7867		

1053

Demand for the Ultimate Fighting Championship: An Econometric Analysis of PPV Buy Rates

Adj R-squared = 0.6045						
Total	6.4309e+12	102		6.3048e+10	Root MSE = 1.6e+05	
buys	Coef.	Std. Err.	t	P > t	[95% Conf.	Interval]
gdppc	-128.5009	44.79534	-2.87	0.006	-218.2728	-38.72907
population	25688.13	10009.01	2.57	0.013	5629.637	45746.63
internatio~l	-32650.73	66158.25	-0.49	0.624	-165234.8	99933.36
tuf	228931.6	73972.21	3.09	0.003	80688	377175.3
pctfree	1899783	789642.8	2.41	0.020	317302.9	3482262
hwtitle	270945.2	97601.36	2.78	0.008	75347.66	466542.7
lhwtitle	86211.65	84022.04	1.03	0.309	-82172.28	254595.6
mwtitle	10013.45	96815.19	0.10	0.918	-184008.5	204035.4
wwtitle	-15070.06	149689	-0.10	0.920	-315053.4	284913.3
lwtitle	16199.57	86552.77	0.19	0.852	-157256	189655.2
fwtitle	-102141.6	187461.6	-0.54	0.588	-477823	273539.8
bwtitle	234430.6	239116.7	0.98	0.331	-244770	713631.2
flwtitle	-330161.2	268752.4	-1.23	0.224	-868753	208430.6
womenstitle	284033.1	153620.7	1.85	0.070	-23829.62	591895.9
titles	112151.2	142923.6	0.78	0.436	-174274.1	398576.5
supercard	-152791.9	198776	-0.77	0.445	-551147.9	245564
liddell	175814.4	77303.92	2.27	0.027	20893.94	330735
couture	60913.99	82776.22	0.74	0.465	-104973.3	226801.2
ortiz	94649.17	96046.78	0.99	0.329	-97832.88	287131.2
hughes	7604.714	101490.6	0.07	0.941	-195787	210996.4
gsp	353206.1	144602	2.44	0.018	63417.21	642995
penn	150747.3	82423.21	1.83	0.073	-14432.52	315927.1
rampage	154484.8	79516.77	1.94	0.057	-4870.422	313839.9
asilva	199864.7	94560.58	2.11	0.039	10361.07	389368.4
jonjones	54312.43	101966.8	0.53	0.596	-150033.7	258658.5
lesnar	380881.3	87106.61	4.37	0.000	206315.7	555446.8
jds	30142.34	128899.3	0.23	0.816	-228177.6	288462.2
velasquez	-136811.2	128585.2	-1.06	0.292	-394501.7	120879.4
rousey	0	(omitted)				
aldo	67865.97	207392.7	0.33	0.745	-347758.3	483490.3
faber	-119792.3	187547.6	-0.64	0.526	-495646.1	256061.5
shogun	96309.51	106340.7	0.91	0.369	-116802	309421.1
dhenderson	-52748.56	91312.68	-0.58	0.566	-235743.3	130246.1
evans	132569.9	72619.65	1.83	0.073	-12963.16	278102.9
franklin	-64549.91	88106.67	-0.73	0.467	-241119.6	112019.8
belfort	177693.6	129738.5	1.37	0.176	-82308.09	437695.3
bisping	-2484.926	183847.5	-0.01	0.989	-370923.6	365953.8
wsilva	-25513.92	126432.6	-0.20	0.841	-278890.4	227862.6
sonnen	134545.5	112949.9	1.19	0.239	-91811.12	360902.1
barao	0	(omitted)				
nickdiaz	120176.3	113837.8	1.06	0.296	-107959.8	348312.3
condit	-28948.48	144841.3	-0.20	0.842	-319217	261320
edgar	9000.209	101431.5	0.09	0.930	-194273.1	212273.5
bhenderson	-67638.47	143376.3	-0.47	0.639	-354971	219694
mir	89041.23	97268.21	0.92	0.364	-105888.6	283971.1
machida	63126.21	98088.01	0.64	0.523	-133446.6	259699

1054

Demand for the Ultimate Fighting Championship: An Econometric Analysis of PPV Buy Rates

serra	-63135.03	138173.9	-0.46	0.650	-340041.7	213771.6
nogueira	143996.8	119403.1	1.21	0.233	-95292.33	383286
sylvia	-186869.3	106085.7	-1.76	0.084	-399469.8	25731.17
_cons	-2166760	1928930	-1.12	0.266	-6032422	1698902

Regression 2B – Reduced to include only significant variables

Source	SS	df	MS	Number of obs = 103		
				F(19, 83) = 12.79		
Model	4.7940e+12	19	2.5232e+11	Prob > F = 0.0000		
Residual	1.6369e+12	83	1.9722e+10	R-squared = 0.7455		
				Adj R-squared = 0.6872		
Total	6.4309e+12	102	6.3048e+10	Root MSE = 1.4e+05		
buys	Coef.	Std. Err.	t	P > t	[95% Conf. Interval]	
gdppc	-110.8322	31.49852	-3.52	0.001	-173.4814	-48.18287
population	26835.76	6941.232	3.87	0.000	13029.93	40641.59
pctfree	1275692	496851.4	2.57	0.012	287475	2263910
international	-81472.43	44977.54	-1.81	0.074	-170931	7986.087
tuf	204791.6	57719.41	3.55	0.001	89990.04	319593.2
hwtitle	183114.6	52317.16	3.50	0.001	79057.88	287171.3
lhwttitle	161543.5	44290.97	3.65	0.000	73450.54	249636.5
womenstitle	250388.6	110072.7	2.27	0.025	31458.54	469318.7
liddell	146242.4	55433.41	2.64	0.010	35987.59	256497.2
couture	91153.15	56463.3	1.61	0.110	-21150.08	203456.4
ortiz	99937.86	71975.22	1.39	0.169	-43217.96	243093.7
gsp	334471	46497.67	7.19	0.000	241989	426953
penn	159032.2	51093.14	3.11	0.003	57409.98	260654.4
rampage	127684.7	61196.61	2.09	0.040	5967.161	249402.3
asilva	218009.1	44277.95	4.92	0.000	129942	306076.1
lesnar	372373.1	64911.15	5.74	0.000	243267.5	501478.8
rousey	0	(omitted)				
evans	125679.9	53239.27	2.36	0.021	19789.18	231570.7
sonnen	123042.8	90768.64	1.36	0.179	-57492.32	303578
mir	106618	72064.27	1.48	0.143	-36714.92	249951
_cons	-3110538	1117647	-2.78	0.007	-5333493	-887583.5

Regression 1C – Reduced to include only significant variables

Source	SS	df	MS	Number of obs = 82		
				F(19, 62) = 18.01		
Model	4.8231e+12	19	2.5385e+11	Prob > F = 0.0000		
Residual	8.7384e+11	62	1.4094e+10	R-squared = 0.8466		
				Adj R-squared = 0.7996		
Total	5.6970e+12	81	7.0333e+10	Root MSE = 1.2e+05		
buys	Coef.	Std. Err.	t	P > t	[95% Conf. Interval]	
gdppc	-156.2218	30.22121	-5.17	0.000	-216.6331	-95.81044
population	33718.18	8187.371	4.12	0.000	17351.86	50084.5
pctfree	1684726	469806.5	3.59	0.001	745596.1	2623856
tuf	273305	52297.65	5.23	0.000	168763.5	377846.5
hwtitle	602985.6	90238.41	6.68	0.000	422601.6	783369.6
wwtitle	438811.1	47461.33	9.25	0.000	343937.2	533684.9

1055

Demand for the Ultimate Fighting Championship: An Econometric Analysis of PPV Buy Rates

lwtitle	85328.77	51569.66	1.65	0.103	-17757.52	188415.1
womenstitle	265490	124137.1	2.14	0.036	17343.41	513636.6
womenstitle-o	273956	138637.8	1.98	0.053	-3177.013	551089.1
penn	110952.6	57402.43	1.93	0.058	-3793.211	225698.5
rampage	149477.4	56615.82	2.64	0.010	36304.01	262650.8
asilva	293229	43107.97	6.80	0.000	207057.4	379400.6
jonjones	200096	49215.31	4.07	0.000	101716	298476
lesnar	258490.4	68313.48	3.78	0.000	121933.7	395047.1
velasquez	-319877	89698.37	-3.57	0.001	-499181.5	-140572.5
shogun	155994.4	66055.62	2.36	0.021	23951.08	288037.7
evans	208281.3	48643.63	4.28	0.000	111044	305518.5
nickdiaz	159913.5	76936.04	2.08	0.042	6120.573	313706.5
nogueira	239037.7	75442.69	3.17	0.002	88229.96	389845.5
_cons	-3233198	1746253	-1.85	0.069	-6723907	257510.8

Regression 2C-Reduced to include only significant variables

Source	SS	df	MS	Number of obs = 82		
Model	4.5706e+12	17	2.6886e+11	F(17, 64) =15.28		
Residual	1.1264e+12	64	1.7600e+10	Prob > F = 0.0000		
				R-squared = 0.8023		
				Adj R-squared = 0.7498		
Total	5.6970e+12	81	7.0333e+10	Root MSE = 1.3e+05		
buys	Coef.	Std. Err.	t	P > t	[95% Conf.	Interval]
gdppc	-126.9153	33.72552	-3.76	0.000	-194.2897	-59.54078
population	24242.3	9121.869	2.66	0.010	6019.269	42465.33
petfree	1357130	525411.6	2.58	0.012	307499.5	2406760
hwtitle	598090.5	96375.55	6.21	0.000	405558.2	790622.8
wwtitle	448967.7	48619.88	9.23	0.000	351838.4	546097.1
womenstitle	418705.1	101973.9	4.11	0.000	214988.8	622421.5
penn	121773	53115.34	2.29	0.025	15662.92	227883.1
rampage	207926.4	61127.72	3.40	0.001	85809.72	330043.1
asilva	238366.6	47137.7	5.06	0.000	144198.2	332535
jonjones	182389.9	54222.54	3.36	0.001	74067.91	290711.8
lesnar	190000.7	75791.11	2.51	0.015	38590.54	341410.8
velasquez	-326361.6	97641.33	-3.34	0.001	-521422.6	-131300.7
shogun	135275.6	73226.76	1.85	0.069	-11011.7	281562.8
evans	236394.7	52967.57	4.46	0.000	130579.8	342209.6
sonnen	222086.9	84291.71	2.63	0.011	53694.84	390478.9
nickdiaz	133579.9	83290.31	1.60	0.114	-32811.65	299971.4
nogueira	278484	81902.18	3.40	0.001	114865.6	442102.4
_cons	-1575176	1941733	-0.81	0.420	-5454233	2303881